WATER QUALITY FACTORS

BACKGROUND

Water resource protection and restoration cannot be fully understood without an awareness of the physical and socioeconomic conditions that influence these issues. A brief overview of demographic and land use conditions was provided in the previous section of this report. In this section, physical factors such as climate, geology, topography, hydrology, soils, wetlands, and forest cover will be introduced, as will be information regarding potable water supply sources in Fairfax County.

This section concludes with an overview of water quality threats and existing pollution sources that have been documented in Fairfax County.

CLIMATE[2]

Fairfax County's climate can be characterized as being temperate and humid. Average annual precipitation ranges from just over 39 inches per year at Ronald Reagan Washington National Airport, which is located in Arlington County (based on a period of record from 1948 to 2003) to just under 44 inches at Tysons Corner (based on a similar period of record). Annual precipitation at Washington Dulles International Airport (identified as "Chantilly" by the Southeast Regional Climate Center), which is located along the County's western boundary, is just over 41 inches per year (based on a period of record between 1962 and 2003). The wettest year during the aforementioned periods of record was 2003, with just over 59 inches of precipitation recorded at National Airport and with over 64 inches recorded at Tysons Corner and Dulles Airport. The driest year during these periods of record was 1965, with just under 27 inches reported at National Airport, nearly 31.5 inches recorded at Tysons Corner, and just under 29 inches recorded at Dulles Airport. Annual average snowfall is 16 inches at National Airport, 20.6 inches at Tysons Corner, and 23.2 inches at Dulles Airport. The highest average maximum temperature occurs in July (88.1, 82.1, and 87.1 degrees F at National Airport, Tysons Corner, and Dulles Airport, respectively) while the lowest average minimum temperature occurs in January (28.3, 26.4, and 22.2 degrees F at National Airport, Tysons Corner, and Dulles Airport, respectively). While precipitation falls throughout the year, precipitation during the cooler fall, winter, and spring months is typically associated with low pressure systems and fronts producing relatively long periods of steady precipitation. In the warmer months of the year, brief, heavy downpours associated with frontal systems or atmospheric convection are more common. In addition, tropical systems occasionally produce prolonged, heavy downpours in the summer and fall months.

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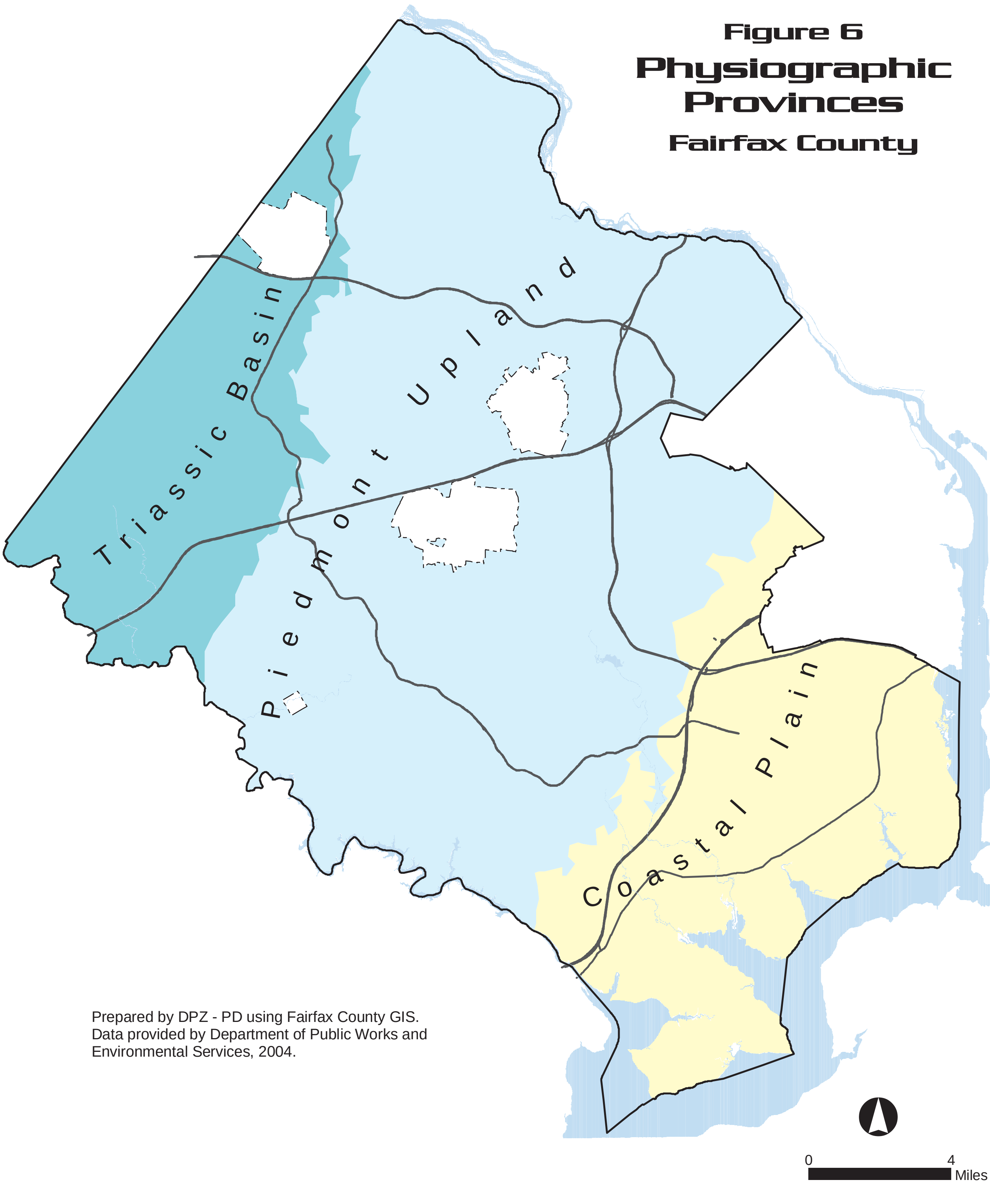
[2] All climatic data presented in this section has been taken from the Southeast Regional Climate Center's Web site at www.dnr.state.sc.us/climate/sercc/index.html.



Prepared by DPZ - PD using Fairfax County GIS.
Data provided by Department of Public Works and
Environmental Services, 2004.

GEOLOGY AND TOPOGRAPHY[3]

Fairfax County straddles the "Fall Line," which is the boundary between the Piedmont Upland and Coastal Plain physiographic provinces. The Fall Line roughly follows the path of Shirley Memorial Highway (I-95 and I-395), with the Coastal Plain located to the east of the Fall Line and the Piedmont Upland located to the west. The western portion of the Piedmont Upland physiographic province in Fairfax County contains a distinct subprovince known as the "Triassic Basin," "Piedmont Lowland," or "Culpepper Basin." The locations of the Coastal Plain, Piedmont Upland, and Triassic Basin in Fairfax County are shown in Figure 6.

The Coastal Plain physiographic province occupies approximately 26 percent of Fairfax County. The province consists of unconsolidated sand, silt, clay, and gravel strata deposited by ancient oceans and freshwater rivers. The overall drainage is to the southeast. Drainage patterns are well developed in the western portion of the province. Broad, level areas are found in the central (Hybla Valley) and southern (Gunston, Mason Neck) portions.

The Piedmont Upland Physiographic Province occupies approximately 56 percent of Fairfax County. It occurs in the central portion of the County, west of the Coastal Plain. The province is underlain by metamorphic rocks, predominantly schist, granite, gneiss, and greenstone. Remnants of the Coastal terrace may be found on high, broad ridge tops in the eastern half of the province. A well-dissected dendritic drainage pattern (resembling the branches of a tree when viewed on a map) occurs throughout the province. The hilltops are typically fairly wide and rolling, except in places along the lower tributaries of large streams. Here, V-shaped valleys with steep slopes and narrow ridge tops occur.

As noted above, the Triassic Basin is actually a subprovince of the Piedmont Upland. It occurs in the western portion of the County, occupying approximately 18 percent of the County's area. The geology consists largely of red sedimentary (sandstone, siltstone, shale, and conglomerate) rocks. Two horseshoe-shaped intrusions of igneous diabase, diorite, and syenite rocks occur in the vicinity of Herndon and Centreville. The drainage is somewhat dendritic, but not as well developed as in the Piedmont Upland. The hilltops are wide and gently rolling, with long gently sloping side slopes and nearly level areas.

The highest natural elevation in Fairfax County is approximately 520 feet above sea level and can be found on a Coastal terrace remnant in the Piedmont Upland Physiographic Province (in the Tysons Corner area of the County). The lowest elevation is slightly above sea level, along the County's tidal shoreline. Relief is generally highest within the Piedmont Upland Physiographic Province, with elevations of ridge tops typically being 100 feet higher than elevations of stream valleys. Relief is particularly high within and near the Potomac Palisades area (along the nontidal portion of the Potomac River upstream of Arlington County), along and near the shoreline of the Occoquan Reservoir and Bull Run, and in the area of the Fall Line.

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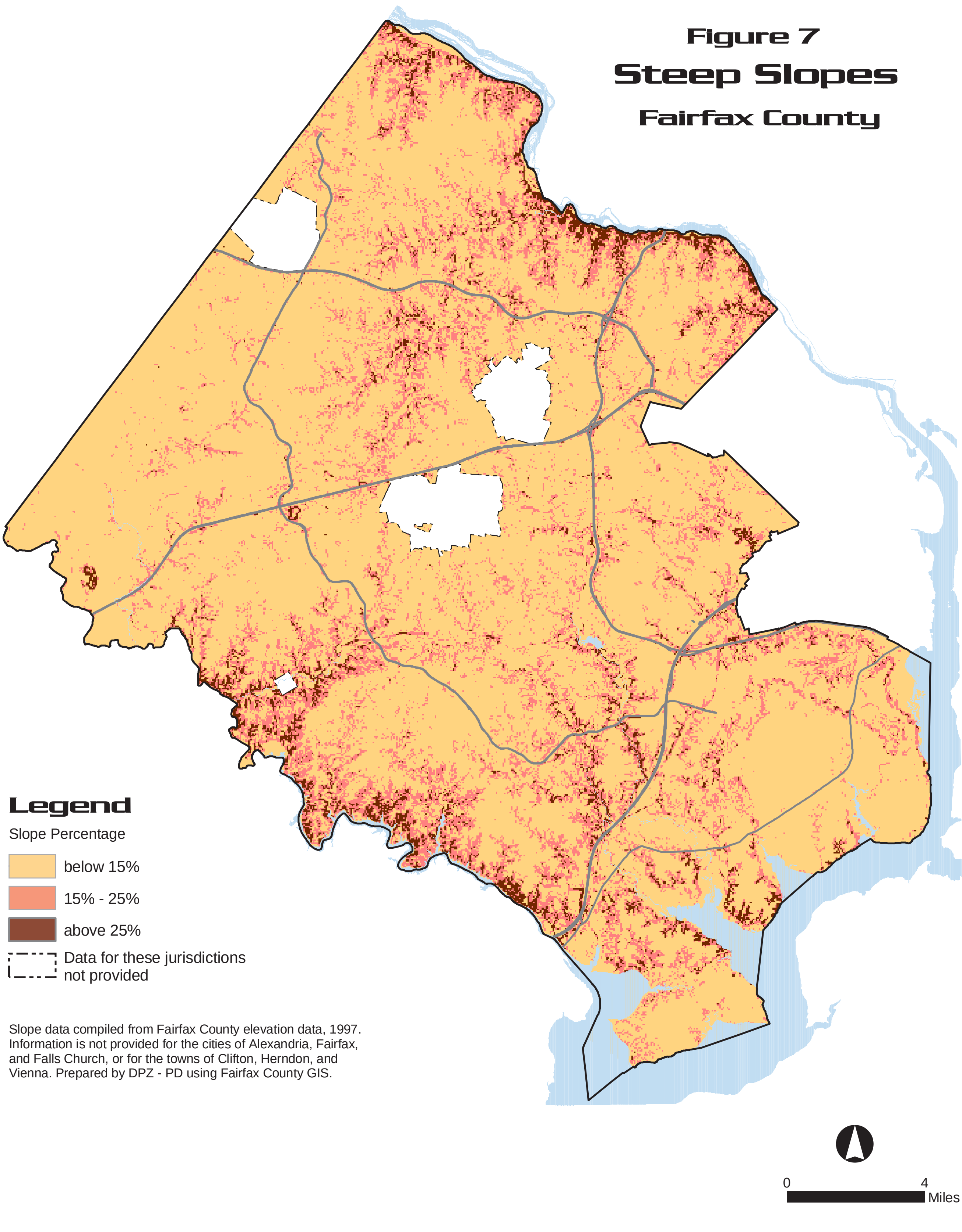
[3] The discussion of physiographic provinces was taken from the Fairfax County Web site entitled "Ratings of Soils for Urban Development in Fairfax County" (http://www.fairfaxcounty.gov/dpwes/environmental/soilrating.htm).



Slope data compiled from Fairfax County elevation data, 1997. Information is not provided for the cities of Alexandria, Fairfax, and Falls Church, or for the towns of Clifton, Herndon, and Vienna. Prepared by DPZ - PD using Fairfax County GIS.

Significant relief is also present in portions of the Coastal Plain, particularly along the edges of Hybla Valley, along the edges of valleys associated with drainageways and embayments outside of the Hybla Valley, and where soils formed from Marine Clay parent materials (locally known as "Marine Clay Soils") are prevalent. In the Triassic Basin, relief is generally more gradual, although there can be significant differences in elevation in the aforementioned areas of intrusive igneous rocks.

Steep slopes (defined by County policy as gradients of 15 percent or greater) can be found throughout most of the County. Areas of steeply sloping terrain are typically associated with stream valleys and embayments, although in the Coastal Plain they are also associated with the edges of Hybla Valley and with soils formed from Marine Clay parent materials. Slopes are particularly pronounced in the high relief areas noted earlier as well as in other areas in the Piedmont Upland Physiographic Province (see Figure 7).

HYDROLOGY

Drainage patterns throughout Fairfax County are generally well developed, with a dendritic pattern characterizing most of the County's stream systems. However, many streams in older developed portions of the County have been piped, and topography is gentle or flat within portions of the Triassic Basin and the Hybla Valley area of the Coastal Plain.

The headwaters of most of the County's stream systems are characterized by ephemeral or intermittent drainage swales or narrow channels. These swales and channels coalesce into larger channels, which, in turn, join with other drainageways to form even larger streams. The stream system is supplied both by surface water runoff and groundwater sources. Rainfall that soaks into the ground moves downward into the groundwater system; seeps and springs are locations where groundwater enters the surface water system; where drainage channels are fed by groundwater seeps or springs, they typically assume a perennial character (that is, they flow throughout the year). There are approximately 850 miles of perennial streams within Fairfax County (excluding the Potomac River, Occoquan River, tidal embayments, and the Occoquan Reservoir) fed by smaller intermittent headwater streams.

The area that drains to a common point along a stream or to a particular water body is known as a "watershed." Watersheds can be of any size or scale, from an area of only a few acres or less upstream of a headwater stream to a broad, regional classification such as the 64,000 square mile Chesapeake Bay Watershed. The boundaries of a "watershed," then, depend as much on definition as on topography. In Fairfax County, 30 watersheds have been recognized, even though the entirety of the County is located within the watersheds of both the Potomac River and Chesapeake Bay. Watersheds that have been designated by Fairfax County are identified in Figure 8, which also displays the network of streams located within each of these watersheds.

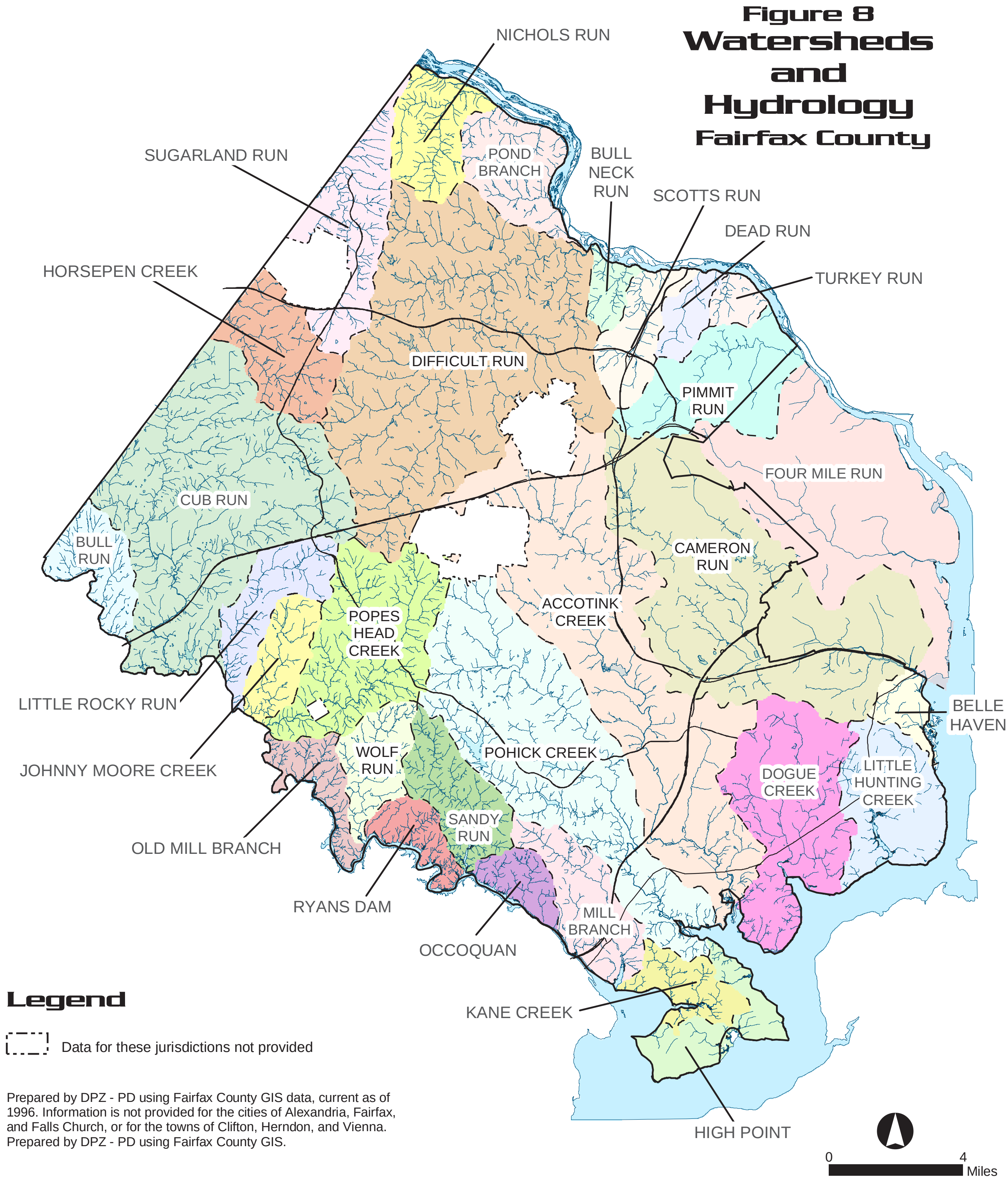


Figure 8
Watersheds
and
Hydrology
Fairfax County
NICHOLS RUN
SUGARLAND RUN
POND BRANCH
BULL NECK RUN
SCOTTS RUN
DEAD RUN
TURKEY RUN
HORSEPEN CREEK
DIFFICULT RUN
PIMMIT RUN
FOUR MILE RUN
CUB RUN
BULL RUN
CAMERON RUN
ACCOTINK CREEK
POPES HEAD CREEK
LITTLE ROCKY RUN
BELLE HAVEN
JOHNNY MOORE CREEK
WOLF RUN
POHICK CREEK
DOGUE CREEK
LITTLE HUNTING CREEK
OLD MILL BRANCH
SANDY RUN
RYANS DAM
MILL BRANCH
OCCOQUAN
KANE CREEK
HIGH POINT
Legend
Data for these jurisdictions not provided
Prepared by DPZ - PD using Fairfax County GIS data, current as of 1996. Information is not provided for the cities of Alexandria, Fairfax, and Falls Church, or for the towns of Clifton, Herndon, and Vienna. Prepared by DPZ - PD using Fairfax County GIS.
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100-YEAR FLOODPLAINS

Floodplains are areas that are periodically subject to inundation by water as a result of rainfall and/or snow melt events causing streams and rivers to spill over their banks. The 100-year floodplain is the area that would be expected to be flooded by the rainfall event that is expected to occur, on average, once every 100 years. Federal programs typically address floodplains of watercourses collecting drainage from one square mile (640 acres) or more of area. The County's definition of "floodplain," as set forth in the Zoning Ordinance, is much more inclusive, in that includes areas adjacent to any stream or watercourse that collects drainage from an area greater than 70 acres. Minor floodplains are associated with streams with drainage areas between 70 and 360 acres. Other floodplain areas, with drainage areas greater than 360 acres, are commonly referred to as "major floodplains." Figure 9 displays streams in Fairfax County that are associated with major floodplains and minor floodplains. Major floodplains are a component of the County's Resource Protection Area designation in the Chesapeake Bay Preservation Ordinance. Other regulatory implications of floodplain designations are described later in this report.

Undisturbed floodplain areas provide water quality benefits by filtering some pollutants from sheet flow runoff from adjacent properties before this runoff enters streams. In addition, floodplains provide temporary storage of overbank flows from larger storm events, thereby reducing adverse impacts in downstream areas when compared with the impacts that would occur if floodplain areas were to be developed.

SOILS

Soils are formed over time through interactions of geology/parent material, climate, organisms, and relief/topography; their characteristics in any location reflect the complexities of these interactions. These soil characteristics, in turn, can affect water resources in a number of ways. Highly permeable soils allow water to percolate downward into the water table, thereby replenishing the ground water system, which, in turn, replenishes the surface water system through seeps and springs. When such soils are covered with impermeable surfaces, groundwater recharge is reduced and surface water runoff during rainfall events is increased. This increased runoff, in turn, can have adverse effects on the ecological health of receiving streams (see the discussion later in this report). Highly permeable soils are also sensitive to adverse water quality issues associated with the release of hazardous materials or other pollutants, in that these pollutants can percolate rapidly through the soil and into the ground water system.

Soil characteristics are also a determinant of the suitability of on-site sewage treatment systems such as septic systems and infiltrative measures of stormwater management. Soils with good percolation characteristics can serve as a filter for septic system effluent or stormwater runoff, reducing pollutant concentrations as the water percolates downward towards the water table. However, soils with excessive permeability or high water tables may not provide sufficient filtering functions, resulting in inadequate sewage treatment and/or pollutant removal, thereby jeopardizing groundwater resources. Conversely, soils that are high in clay content or that otherwise have slow percolation rates may not provide sufficient capacity to accept wastewater from on-site sewage disposal systems and may not have sufficient capacity to allow for the provision of infiltration stormwater management practices.

Soil erodibility is a key water quality concern in jurisdictions such as Fairfax County that have experienced and continue to experience significant land development. As the vegetated ground cover is removed from a development site and soils are exposed to rainfall, particles are entrained from the surface and carried away by stormwater runoff. If not trapped on the site by erosion and sediment control measures, these sediments and their associated pollutants can degrade downstream water quality, thereby reducing the ecological value of receiving streams. Ultimately, these sediments and their associated pollutants can enter the Potomac River and Chesapeake Bay.

Soil conditions can also have an effect on development suitability of properties. Some soils in Fairfax County, for example, contain significant amounts of clay particles with high shrink-swell potentials. In extreme cases, such soils can become unstable, resulting in slope failures. Even in less extreme cases, these soils can cause substantial damage to foundations of structures if engineering solutions are not taken in the design and construction of these structures.

A general soil map of Fairfax County is provided in Figure 10. As can be seen from this map, the distribution of soil associations in Fairfax County is greatly influenced by geology; the Coastal Plain, Piedmont Upland, and Triassic Basin each have their own distinct soil associations.

Highly permeable soils are generally not present within Fairfax County. However, many soils in the County are characterized by slow rates of infiltration and permeability and therefore present constraints to the provision of on-site sewage disposal facilities. This issue is discussed in more detail later in this section of the report.

In terms of soil erodibility, the County has characterized the erosion potential of soils under construction site conditions in all areas of the County where soils have been mapped. The results, presented in Figure 11, illustrate that, under construction conditions, soils outside of stream valleys throughout much of the County are characterized by moderate to severe erosion potential, with some notable exceptions (generally the areas characterized by a flat or gentle topography). It is important to recognize that Figure 11 does not illustrate soil erodibility under natural conditions; it should not be interpreted to reflect erodibility factors applied in the Revised Universal Soil Loss Equation or to reflect soil loss tolerance values applied for agricultural planning purposes. Rather, Figure 11 illustrates the need for sensitivity to erosion and sediment controls during the construction process in order to protect County streams from degradation. It should also be recognized that soil erodibility within a soil may vary with depth. Many upland areas of the Piedmont Upland province in Fairfax County, for example, contain soils that are considered to have a moderate erosion potential, even though their parent materials, if exposed, would have a severe erosion potential.

The Natural Resources Conservation Service, in coordination with the Northern Virginia Soil and Water Conservation District, is developing an updated soil survey for the entirety of Fairfax County. This survey will include those areas that have not, to date, been mapped.

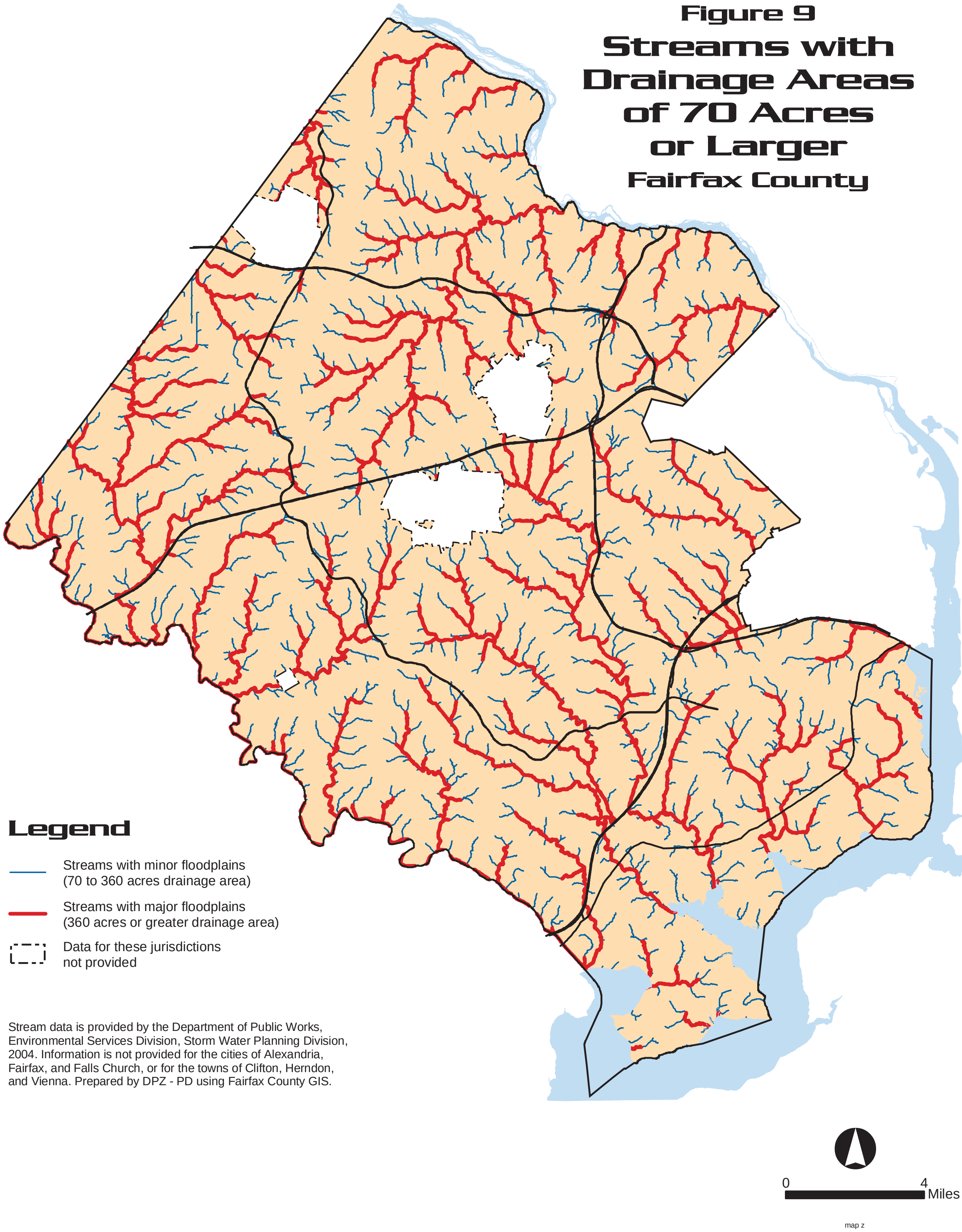
Figure 9
Streams with Drainage Areas of 70 Acres or Larger
Fairfax County
Legend
Streams with minor floodplains (70 to 360 acres drainage area)
Streams with major floodplains (360 acres or greater drainage area)
Data for these jurisdictions not provided
Stream data is provided by the Department of Public Works, Environmental Services Division, Storm Water Planning Division, 2004. Information is not provided for the cities of Alexandria, Fairfax, and Falls Church, or for the towns of Clifton, Herndon, and Vienna. Prepared by DPZ - PD using Fairfax County GIS.
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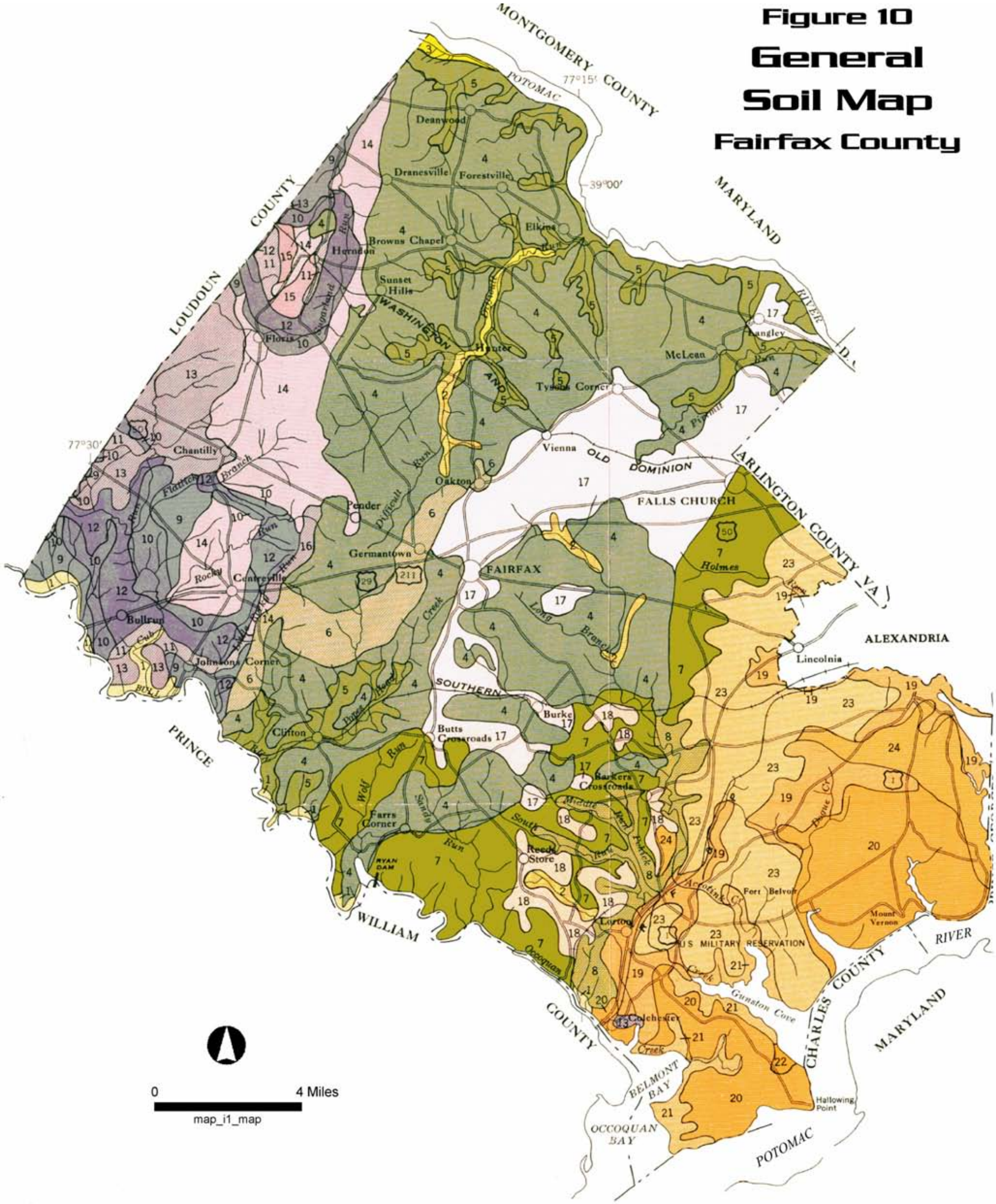

Figure 10
General Soil Map
Fairfax County

Legend

(For Figure 10)

SOIL ASSOCIATIONS

SOILS ON ALLUVIAL DEPOSITS

1 Rowland-Bermudian-Bowmansville.

2 Chewacla-Wehadkee.

3 Huntington-Lindside.

SOILS ON CRYSTALLINE ROCK OF THE PIEDMONT UPLAND

4 Glenelg-Elioak-Manor.

5 Manor-Glenelg-Elioak.

6 Orange-Bremo-Elbert.

7 Appling-Louisburg-Colfax.

8 Louisburg-Appling-Worsham.

SOILS ON SANDSTONE, SHALE, AND CONGLOMERATE OF THE PIEDMONT LOWLAND

9 Penn-Calverton-Croton.

10 Brecknock-Catlett-Croton.

11 Kelly-Brecknock-Catlett.

12 Iredell-Mecklenburg-Rocky land.

13 Calverton-Readington-Croton.

14 Penn-Bucks-Calverton (Sandy).

15 Calverton-Brecknock-Croton (Loams).

16 Mayodan-Calverton-Penn.

SOILS ON MIXED CRYSTALLINE ROCKS AND OLDER COASTAL PLAIN SEDIMENTS

17 Fairfax-Beltsville-Glenelg.

18 Fairfax-Beltsville-Appling.

SOILS ON COASTAL PLAIN SEDIMENTS

19 Lunt-Hilly and Steep land, loamy and gravelly sediments-Beltsville

20 Matapeake-Mattapex-Woodstown.

21 Hilly and Steep land, loamy and gravelly sediments-Woodstown-Matapeake.

22 Galestown-Sassafras-Woodstown.

23 Beltsville-Elkton-Sassafras.

24 Beltsville-Hilly and Steep land, loamy and gravelly sediments-Matapeake.

Source: USDA General Soil Map of Fairfax County, Virginia, 1963

map_i1_legend

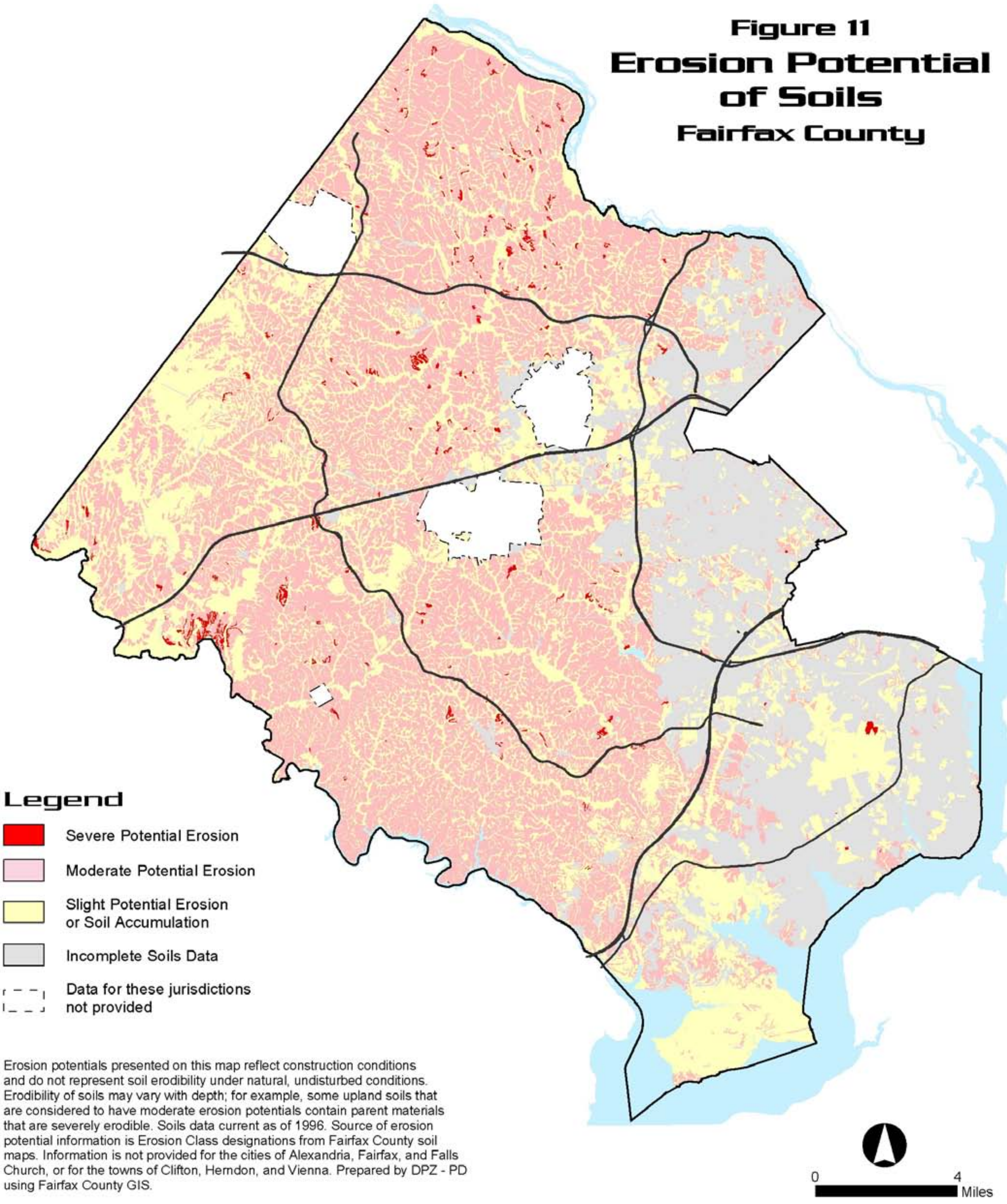
Figure 11
Erosion Potential of Soils
Fairfax County
Legend
Severe Potential Erosion
Moderate Potential Erosion
Slight Potential Erosion or Soil Accumulation
Incomplete Soils Data
Data for these jurisdictions not provided
Erosion potentials presented on this map reflect construction conditions and do not represent soil erodibility under natural, undisturbed conditions. Erodibility of soils may vary with depth; for example, some upland soils that are considered to have moderate erosion potentials contain parent materials that are severely erodible. Soils data current as of 1996. Source of erosion potential information is Erosion Class designations from Fairfax County soil maps. Information is not provided for the cities of Alexandria, Fairfax, and Falls Church, or for the towns of Clifton, Herndon, and Vienna. Prepared by DPZ - PD using Fairfax County GIS.
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WETLANDS

By federal definition, wetlands are "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Tidal wetlands are wetlands located within the influence of tidal action (defined by Virginia as "lands lying between and contiguous to mean low water and an elevation above mean low water equal to one and one-half times the mean tide range . . ."), while nontidal wetlands include all other wetland areas. Wetlands provide a variety of important water quality and habitat functions. They provide habitat for a wide range of plants and animals and protect other water resources through the uptake and filtering of pollutants and through the detention and/or reduction in velocity of flood waters and other storm drainage. The recognition of the many environmental values of wetlands has resulted in the inclusion of certain wetlands as core Resource Protection Area (RPA) components requiring the restoration and/or protection of 100-foot buffer areas (see the first section of this report).

Wetlands are defined based on the presence of hydrophytic ("water loving") vegetation, hydric soils (soils with evidence of at least periodic saturation during the growing season), and hydrology that indicates inundation or saturation for at least part of the growing season. On-site surveys are needed to confirm the presence of a wetland and, where present, to define its boundaries. To date, there has not been a comprehensive map produced of wetland resources in Fairfax County. However, there are several map resources available to assist in the determination of areas with high potential for wetlands; these resources have been used in the estimation of wetland locations for the purpose of mapping Resource Protection Areas. Included as such resources are the U.S. Fish and Wildlife Service's National Wetlands Inventory maps, the County's soils map along with its list of soils that are typically hydric, County topographic maps, and County tidal wetland maps. The County's Department of Public Works and Environmental Services has prepared a draft map identifying potential wetland areas based on the above resources; refinements are anticipated prior to completion of the final map. A copy of the draft map is presented in Figure 12.

Fairfax County contains both tidal and nontidal wetlands. Tidal wetlands are located along tidal shorelines in the Coastal Plain Physiographic Province, while nontidal wetlands are located in areas throughout the remainder of the County. In general, nontidal wetlands are concentrated in stream valley areas, but isolated upland wetlands are present in places as well. All tidal wetlands and certain nontidal wetlands (those that are contiguous and connected by surface flow to other RPA core area features) are included as core RPA features requiring 100-foot buffer areas. Other nontidal wetlands are subject to regulation under Section 404 of the Clean Water Act, which is administered by the U.S. Army Corps of Engineers in coordination with the Virginia Department of Environmental Quality. In addition, many activities proposed for tidal wetland areas are subject to the review and approval of the County's Wetlands Board.

Development proposals requiring wetlands permits from the U.S. Army Corps of Engineers typically are required to provide compensation or mitigation for jurisdictional wetlands that will be filled. The U.S. Army Corps of Engineers is not required to seek compensation efforts within the same political jurisdiction as the wetland impacts, and developers of some projects involving

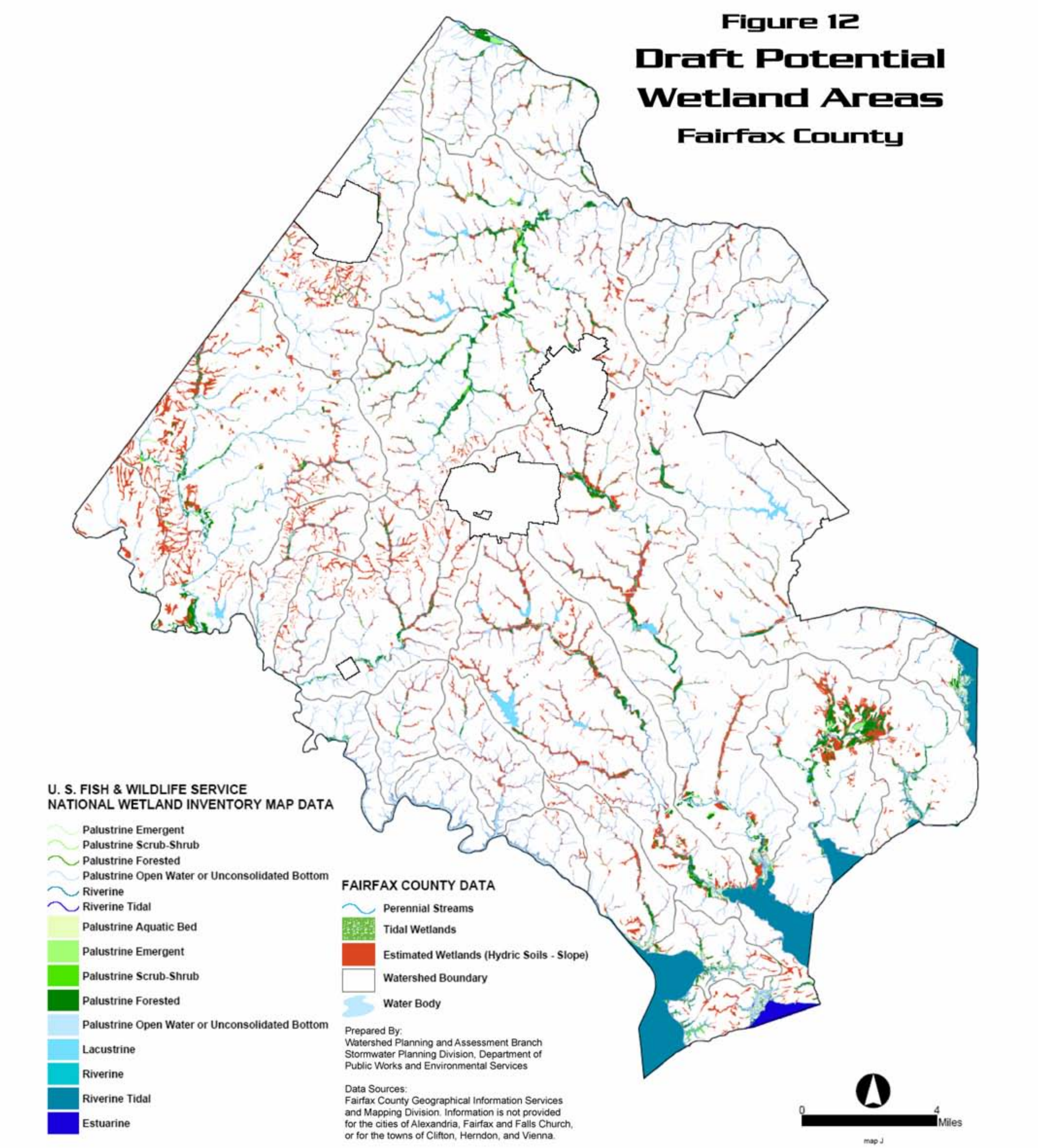
Figure 12
Draft Potential Wetland Areas
Fairfax County
U. S. FISH & WILDLIFE SERVICE
NATIONAL WETLAND INVENTORY MAP DATA
Palustrine Emergent
Palustrine Scrub-Shrub
Palustrine Forested
Palustrine Open Water or Unconsolidated Bottom
Riverine
Riverine Tidal
Palustrine Aquatic Bed
Palustrine Emergent
Palustrine Scrub-Shrub
Palustrine Forested
Palustrine Open Water or Unconsolidated Bottom
Lacustrine
Riverine
Riverine Tidal
Estuarine
FAIRFAX COUNTY DATA
Perennial Streams
Tidal Wetlands
Estimated Wetlands (Hydric Soils - Slope)
Watershed Boundary
Water Body
Prepared By:
Watershed Planning and Assessment Branch
Stormwater Planning Division, Department of
Public Works and Environmental Services
Data Sources:
Fairfax County Geographical Information Services
and Mapping Division. Information is not provided
for the cities of Alexandria, Fairfax and Falls Church,
or for the towns of Clifton, Herndon, and Vienna.
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Example of a forested tidal wetland located east of Sandy Point, Mason Neck State Park.
Photo: Beth Rado

wetland losses in Fairfax County have pursued compensation efforts in other jurisdictions. Staff from the Fairfax County Department of Public Works and Environmental Services has coordinated with the U.S. Army Corps of Engineers to identify watershed restoration opportunities in Fairfax County that can be sought as compensation for wetland losses in the County based on the recently-completed Countywide Stream Physical Assessment project. More information about the Countywide Stream Physical Assessment is provided later in this report.

TREE COVER

As noted earlier in this report, English settlement began in Fairfax County in the early 1600s. The settlement of the County and the use of its resources over several centuries resulted in the clearing of the County's pre-settlement vegetation long before the County's rapid increase in population (and the associated land development) in the latter half of the 20th century; indeed the County was largely agricultural in character prior to its emergence first as a bedroom community for Washington, D.C. and later as an employment center in its own right. However, prior to

Figure 13
Total Acres of Tree Cover by Year, 1973-2004

Data provided by the Urban Forestry Division of the Fairfax County Department of Public Works and Environmental Services.
k_chart

development of much of the County's land, secondary growth forests had reclaimed much of the land that had been farmed, and much of the undeveloped land remaining in the County is characterized by a mature deciduous forest cover. More recent trends have seen a steady decline in tree cover in Fairfax County (see Figure 13)[4]. It is estimated that, in 1973, there were nearly 200,000 acres of land with tree cover in the County, or 79% of the County's land mass. While this number may be somewhat inflated due to the resolution of imagery that was used in the tree cover analysis, it is likely that the actual tree cover exceeded 70% of the County's land mass. The estimated tree cover in 2003 was 122,400 acres, or 48% of the County's total landmass.

[4] It should be noted that term "tree cover" includes areas characterized by relatively high densities of development with large, mature trees. "Tree cover" and "forest" are not synonymous.

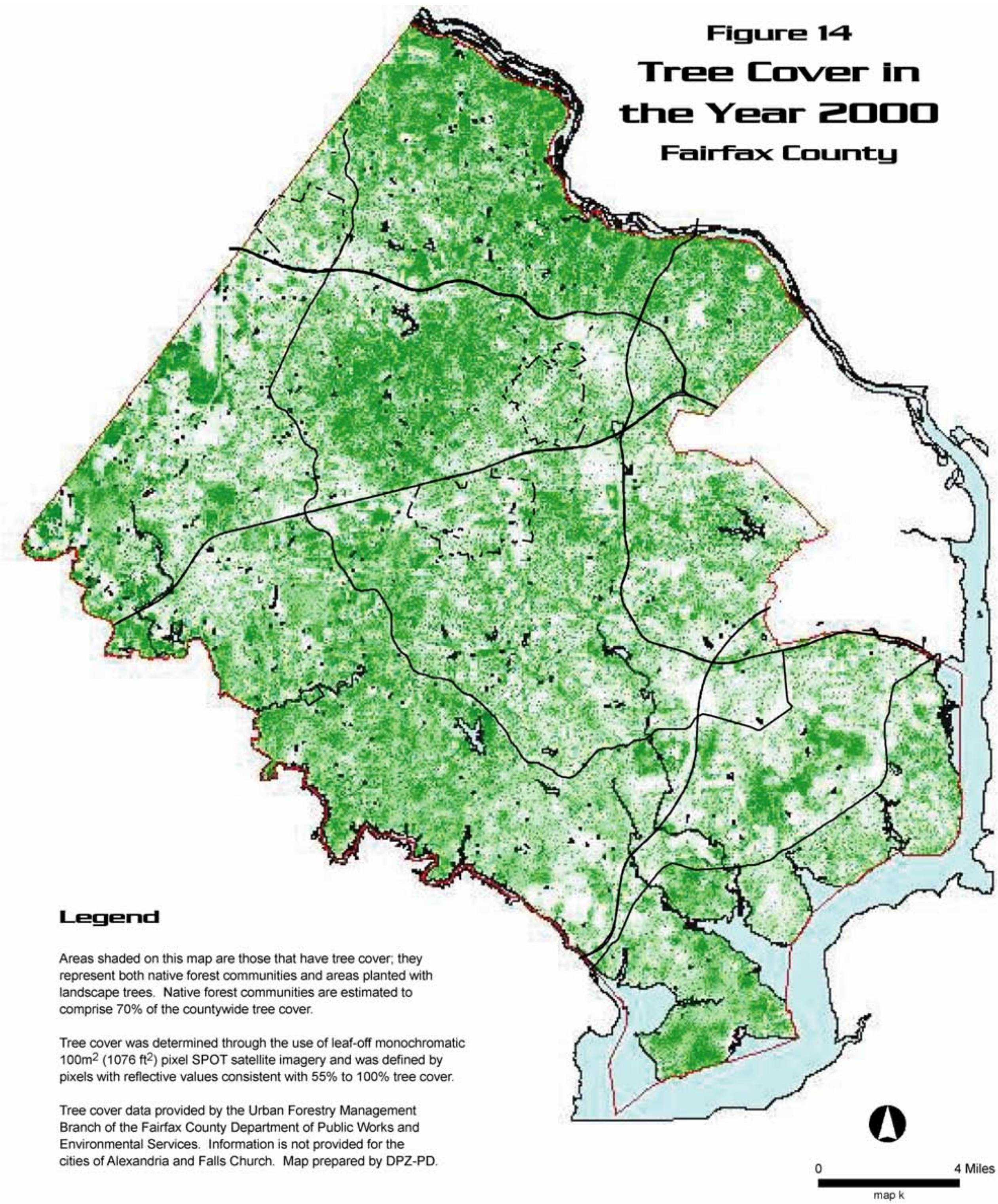
Figure 14
Tree Cover in the Year 2000
Fairfax County
Legend
Areas shaded on this map are those that have tree cover; they represent both native forest communities and areas planted with landscape trees. Native forest communities are estimated to comprise 70% of the countywide tree cover.
Tree cover was determined through the use of leaf-off monochromatic 100m^2 (1076 ft^2) pixel SPOT satellite imagery and was defined by pixels with reflective values consistent with 55% to 100% tree cover.
Tree cover data provided by the Urban Forestry Management Branch of the Fairfax County Department of Public Works and Environmental Services. Information is not provided for the cities of Alexandria and Falls Church. Map prepared by DPZ-PD.
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Again, this figure may be inflated somewhat due to the resolution of the imagery; it is likely that the actual figure fell somewhere between 40% and 45%. Regardless of the precise figure, it is clear that there has been a steady decline of tree cover over the last 30 years, with an average decrease per year of roughly 1%. As can be seen in Figure 13, however, this trend reversed for a few years in the mid to late 1990s, suggesting that the growth in the planted and natural tree cover during this period outpaced the removal of tree cover due to land development (or that the quality of imagery used in the analysis changed, resulting in changes in interpretations). The last several years have again seen a decreasing trend; it is not clear whether this trend will reverse if and when the pace of development in the County again slows.

At this time, large tracts of unfragmented forest are generally limited to park and other government-owned lands, stream valley corridors, and areas within the far western, southern, and northern portions of the County. The County has been active in acquiring many of the remaining large tracts of forested land and recently acquired, through purchase and dedication, over 2,000 acres of land in the western part of the County that includes a large, generally unfragmented, rare basic oak hickory forest formed on diabase-derived soils. In addition, the County has partnered with the Northern Virginia Conservation Trust to seek voluntary agreements from land owners to protect high quality resources on their properties (these and other County initiatives are addressed later within this report).

While large tracts of unfragmented forested land are not common in Fairfax County, substantial areas of tree cover remain in areas throughout the County, including areas characterized by relatively high densities of residential development (see Figure 14). While these areas lack the habitat values of unfragmented land, the County's tree cover serves important water quality functions by reducing the erosive force of rainfall (through interception of raindrops by the tree cover and, where leaf litter has not been removed by land owners, by softening the impact of raindrops on the ground), providing for infiltration and vegetative uptake of rainfall, thereby reducing runoff, erosion, and the associated conveyance of nonpoint source pollutants, and shading impervious surfaces and streams, thereby reducing the potential for adverse thermal impacts to streams. In addition to water quality benefits, tree cover provides energy conservation benefits (through reducing the urban "heat island" effect and by shading structures), habitat benefits, air quality benefits, property value benefits, and reductions in carbon dioxide, which has been linked to global warming. A document produced for the Chesapeake Bay Program by the United States Department of Agriculture Forest Service entitled "Chesapeake Bay Watershed Forestry 2003" highlights the following benefits of forests:

> "Scientific findings show that forests are the most beneficial land use for water quality. Forests enhance water quality by filtering out large amounts of pollution and nutrients before they enter streams, rivers, and the Bay. By providing shade and enhanced water retention, forests reduce water temperature, prevent soil erosion, and mitigate flooding. Forests also provide important terrestrial habitat for many species of wildlife and protect aquatic habitat throughout the Bay watershed. Finally, trees themselves are a living resource that contribute to the economy, improve air quality, provide recreational opportunities, and enhance the quality of life for residents throughout the watershed. Restoration and protection of forests is fundamental to saving the Bay."

Of particular interest and importance from a water quality standpoint is the presence of undisturbed forested areas (including native herbaceous and shrub cover) along the County's streams. Forested riparian buffer areas perform a number of environmental functions, including:

- The provision of valuable unfragmented plant and wildlife corridors;
- The removal of nutrients and other pollutants from surface water and groundwater;
- The shading of streams and other bodies of water, thereby reducing the potential for adverse thermal impacts;
- The improvement of stream habitat conditions;
- The trapping of sediment from flood waters and sheet flow entering from developed and/or developing areas; and
- The separation of activities that may have an adverse impact on water resources (e.g., lawn fertilization and use of pesticides) from these resources.

The County has embarked on an ambitious effort to prepare watershed management plans for each of its 30 watersheds. As part of this effort, baseline stream assessments have been performed for all streams in the County to evaluate their conditions and to identify deficiencies such as insufficient riparian buffer areas. A more complete discussion of this effort, and an overview of the results of the stream assessments, is provided later in this report.

POTABLE WATER SUPPLY SOURCES IN FAIRFAX COUNTY

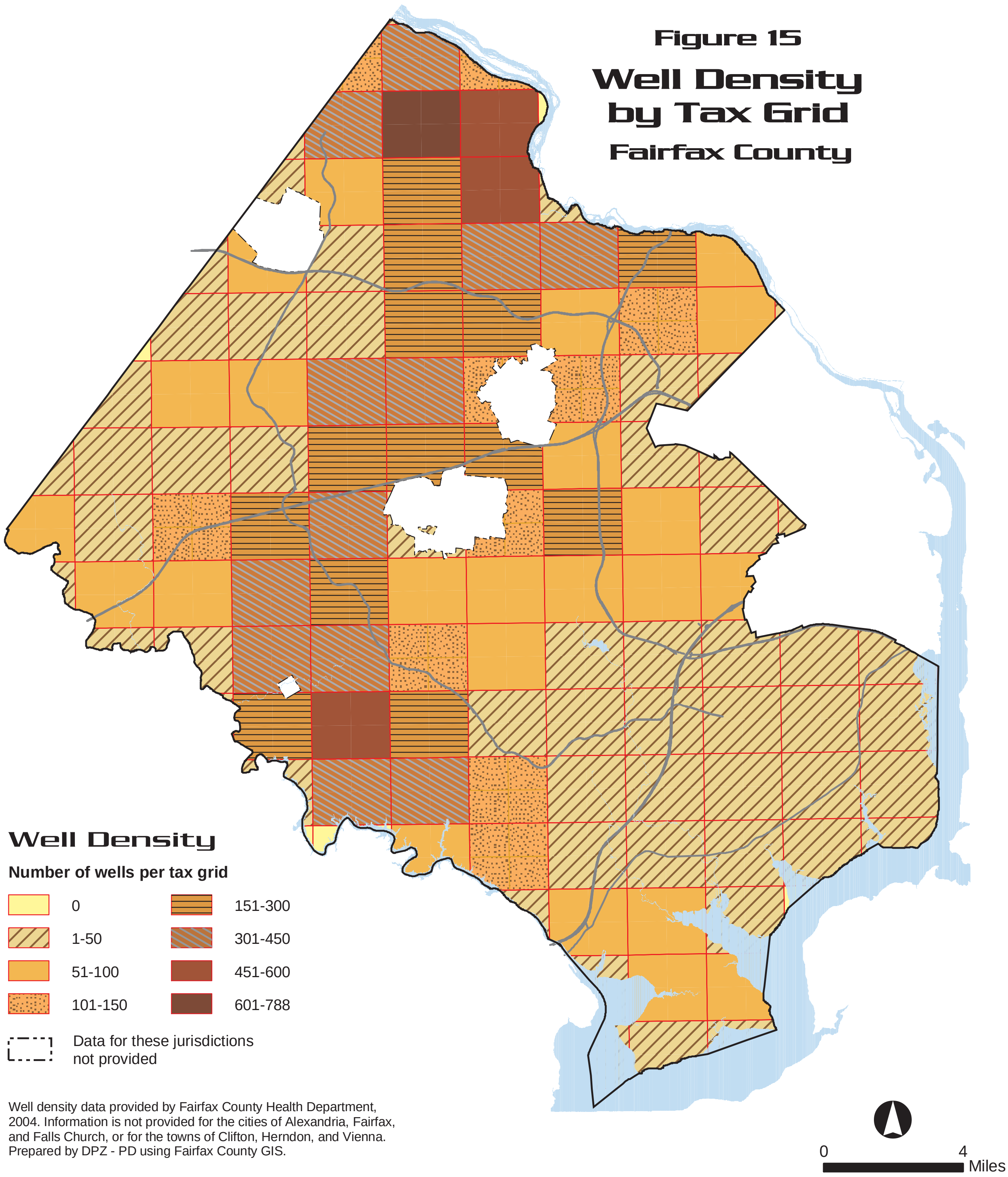
Fairfax County's water supply comes from the Potomac River, the Occoquan Reservoir, Goose Creek, community wells, and private wells. Fairfax Water (formerly the Fairfax County Water Authority), is the County's primary supplier of drinking water, but some areas of the County have water service provided by other jurisdictions. Fairfax Water also provides drinking water to the Prince William County Service Authority, Loudoun County Sanitation Authority, Virginia America Water Company (City of Alexandria and Dale City), Town of Herndon, Fort Belvoir, and Dulles Airport. Fairfax Water's production was 48.99 billion gallons in 2003.

TABLE 4
Sources of Fairfax Water's Water Supply, 2003

Sources	Gallons (in billions)
Occoquan Reservoir (Lorton/Occoquan)	19.84
Potomac (Corbalis)	29.01
Wells	0.01
Purchased	0.05
Untreated	0.08
TOTAL	48.99

Source: Fairfax Water (formerly the Fairfax County Water Authority). Note that this information does not include private well water supplies.

There are approximately 12,000 single family residences and businesses that are served by individual well water supplies in Fairfax County. While there are no areas in the County for which surface water supply pipes are not permitted, houses continue to be constructed in areas



Well density data provided by Fairfax County Health Department, 2004. Information is not provided for the cities of Alexandria, Fairfax, and Falls Church, or for the towns of Clifton, Herndon, and Vienna. Prepared by DPZ - PD using Fairfax County GIS.

where access to existing water mains is limited by physical distance and where groundwater supplies are sufficient. In 2003, for example, 163 New Well Permits were issued by the County's Health Department for single family residences. There were, by comparison, 321 wells closed in 2003. In addition, there are 75 non-community well water supplies that serve facilities in the County such as schools, restaurants, parks, and other commercial use buildings. These wells serve at least 25 people for at least six months out of the year. They are sampled for potability quarterly. The results are posted with the Virginia Department of Health, Office of Drinking Water.

In general, ground water supplies are taken from unconfined aquifers. The only substantial area where there are known confined aquifers is the Coastal Plain Physiographic Province, where sedimentary layers of rock dip toward the southeast. The Coastal Plain contains a significant aquifer that is recharged in the area along the western boundary of the Coastal Plain, roughly along I-95. Two areas along the Fall Line (the boundary of the Coastal Plain and Piedmont Upland Physiographic Provinces) in Fairfax County have been identified as recharge areas for the principal confined Coastal Plain aquifer (one such area is located along, but primarily east, of I-395 north of the Capital Beltway and along the Beltway in the Franconia area, and the other between I-95 and Richmond Highway in the Lorton area), although this aquifer could, potentially, be recharged from a broader area in the Coastal Plain near the Fall Line. While this aquifer is not a significant source of Fairfax County's water supply, it may provide potable water for jurisdictions east of the County. Ideally, groundwater recharge areas such as the Fall Line area of Fairfax County should be kept in low density development. However, the Fall Line aquifer recharge areas in Fairfax County have long been characterized by relatively high density residential, commercial, and industrial development.

In general, areas characterized by high groundwater well use in Fairfax County (see Figure 15) are in Piedmont Upland areas where groundwater is unconfined and tends to move in fractures and faults within bedrock. There are, however, other areas in the County where there are fewer wells but where groundwater serves as the primary source of potable water (e.g., the Mason Neck area of southern Fairfax County and the low density residentially-zoned areas of far western Fairfax County). The Mason Neck wells are supplied by Coastal Plain aquifers, while the western portion of the County is located in the Triassic Basin area, where groundwater moves in fractures and faults within bedrock but where the system of fractures in some areas tends to be more extensive than that of the Piedmont Upland, thereby resulting in a more regional groundwater system.

The County recognizes the need for water conservation measures in support of preserving and protecting its water supply. Toward this end, the County, under the auspices of the Metropolitan Council of Governments, supports and follows the Metropolitan Washington Water Supply and Drought Awareness Response Plan: Potomac River System. The Plan consists of two interrelated components: 1) a year-round program emphasizing wise water practices and 2) a water supply and drought awareness and response plan. In addition, Fairfax Water's "Water, Use It Wisely" program provides water conservation tips on its internet site and in its newsletters. Fairfax Water also offers plant tours and staff presentations on water supply and water treatment issues to complement organizations' watershed protection efforts. ■